ASTROBIOLOGICAL APPLICATIONS OF THE MBARI ENVIRONMENTAL SAMPLE PROCESSOR (ESP). S. M. Feldman[1], C. Scholin[2], J. Feldman[2], S. Jensen[2], B. Roman[2], C. Preston[2], V. Orphan[3], and J. Dzenitis[4] [1]NASA Ames Research Center, MS 239-4, Moffett Field, CA 94035 (Sabrina.M.Feldman@nasa.gov), [2]Monterey Bay Aquarium Research Institute, [3]California Institute of Technology, [4]Lawrence Livermore National Laboratory.

The Monterey Bay Aquarium Research Institute (MBARI) has developed an Environmental Sample Processor (ESP) for autonomously sampling and detecting microbes found in terrestrial ocean environments. This instrument can readily be adapted for exploring deep-sea seep and hydrothermal vent fluids as one step towards developing the scientific and technical capability for searching for life on other planets. With moderate modifications, the ESP could also be adapted for Martian surface applications including detection of astrobiologically relevant prebiotic and biotic compounds that may exist in dry, icy, or liquid samples.

The ESP provides an autonomous platform for sample acquisition, processing, and distribution, and enables a variety of molecular probe chemistries as well as options for sample archival. Furthermore, the architecture of the ESP permits expansion of analytical functions that share a common requirement for front-end sample collection and processing prior to delivery to a particular analyte detector.

The first generation ESP has already been demonstrated in the field and a second generation is currently under development in the laboratory. The ESP consists of five major subsystems: carousel, shuttle, clamp, syringe pump, and CCD camera (Fig. 1). The carousel stores ~100 "pucks", or reaction chambers, which accommodate a wide variety of user-defined 25 mm diameter filters or chemically adsorptive media. An elevator and linear shuttle are used to move a puck from the carousel to the processing position where it is sealed in a clamp, thus providing connections to the sample port and reagent valve manifolds. The seals used in the clamp have embedded heater pads for temperature control from ambient to ~100°C at any time during a protocol. The shuttle is also used to move pucks to an imaging station where a CCD camera records results of DNA probe array assays. A syringe pump draws in seawater samples and dispenses the required reagents. Modular valving supports use of up to 16 different custom-defined reagents.

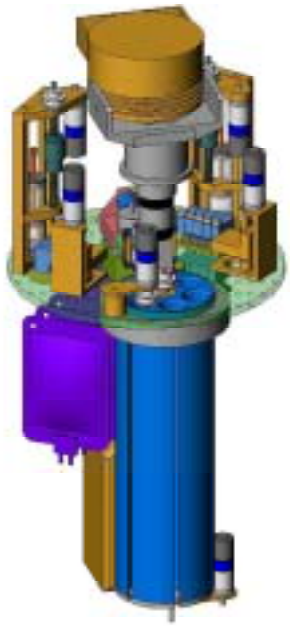

Figure 1. Solid model of the second generation ESP. The rotating carousel, CCD camera, puck clamps, syringe pumps, valving and reagent bags are visible. The ESP is protected under US Patent No 6187530.

In order to illustrate the capabilities of the ESP, we will present results from the first generation instrument and describe modifications to the ESP which could allow it to be used for (1) evaluating the diversity and abundance of thermophilic and methanotrophic microorganisms present in deep-sea hydrothermal vents; and (2) detecting a variety of organic compounds on the Martian surface.